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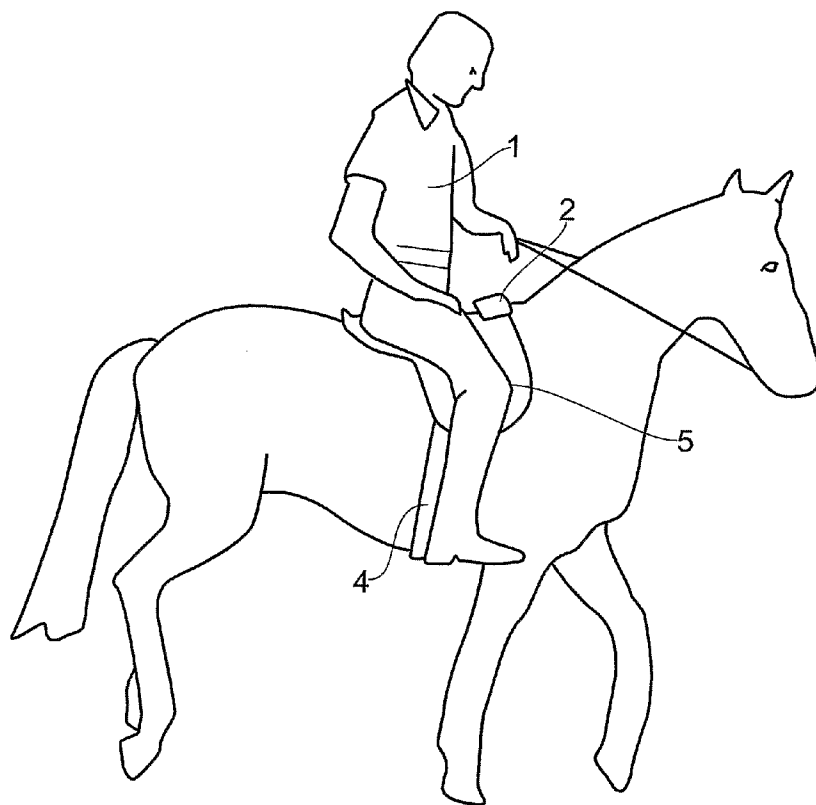
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(54) Title: METHOD AND APPARATUS FOR REAL TIME PERFORMANCE ASSESSMENT



(57) Abstract: An apparatus for monitoring performance comprises two elements: a first element (4) for attaching to a human or animal, containing two or more of physiological, biochemical, kinematic, and/or environmental sensors and a processing means which records in memory signals or derivatives of signals from said sensors and contains a means of re-transmitting this data to a second element, and a second element (13, 16) containing a display (12, 17) or audio output to present the processed live or previous recorded data to the user.

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Method and apparatus for real time performance assessment

RELATED APPLICATIONS

This application claims priority from US provisional patent application entitled
5 "Method and apparatus for real time performance assessment" to Cane et al, serial number 60/800,783, filed May 16 2006, the contents of which are hereby incorporated in their entirety.

BACKGROUND

10 Monitoring equine fitness is important when both training and competing to ensure that training is efficient without prejudicing animal health and welfare whilst aiming for maximal performance. The more information that can be acquired about the horse's metabolic and physiological status during a given workout, the better the assessment of performance, such that data driven decisions can be made to optimize training.

15 An important aim of training is to stimulate the animal's physiology to adapt to a higher level of exertion, thus improving performance. Different equine sports require different optimizations, for example some events favor endurance (predominantly slow twitch muscles, aerobic exercise) and some favor sprint performance (predominantly fast twitch muscles, and anaerobic exercise) such as
20 thoroughbred racing or show jumping. Training aims to stress aspects of the horse's physiology so that fatigue and the resulting compensation lead to adaptation and improved performance over the medium term.

Research has shown that different levels of exercise intensity stress different aspects of the horse's physiology and metabolism. These levels depend both on
25 the natural ability of the animal and it's current level of fitness. These levels can be determined by the measurement of a number of indicators including analysis of blood chemistry, or more conveniently by measurement of heart rate relative to the individual's maximum heart rate. This measurement is useful in determining a

desired level of exercise during training to achieve the continued improvement as the horse's fitness progresses. The ability of the horse to recover after exercise is also a measure of fitness. This can be determined by monitoring changes in heart rate over time relative to the horse's maximum and resting heart rates. Additionally
5 the ability of the muscles to tolerate high levels of lactic acid has been used as an index of performance. Blood lactic acid level has been correlated to heart rates to indicate when exercise is in the aerobic or anaerobic zones.

Over training can lead to injury including dehydration, metabolic distress and damage to bone, ligament, tendon and cartilage, some of which is irreversible. It is
10 therefore important to choose a training regime that stresses the relevant aspect of the animal's physiology, maximizing that stress consistent with the level of fitness of the animal and to do this without causing injury or distress. Providing a complete picture of the horses metabolic and physiologic state with kinetic (speed, acceleration, distance, elevation) data and ambient conditions in combination with
15 feed, farrier, radiological, immunization and therapeutic regimens will result in the most complete data set on which to derive training profiles and assess performance output for individual horses.

Current practice relies on the experience of the trainer and in some cases 'static' physiological measurements taken before and after training, and on trackside
20 measurements of speed. These measurements include body temperature, weight, heart rate, respiration rate and in some cases blood chemistry. Performance improvement is most often measured by timing the horse over a standard course.

Recently, equine heart rate monitors (manufactured by Polar, Garmin and others) have been introduced and are used during training or competition allowing a
25 'dynamic' or continuous monitoring of heart rate during exercise. These systems can provide a read out of heart rate and speed when combined with a built in GPS system. Data may be displayed to the rider via a wrist or arm mounted display unit. These devices can be programmed to trigger alerts based on reaching certain heart rates. These systems may log data for download after use to a PC.
30 The trainer then uses software supplied with the monitor to compare performance against previous training sessions to assess changes in performance.

This data can be combined with observations of behavior, feeding, body weight or

condition, gait, body temperature and respiratory rate to assess the health of the animal, to regulate feeding, and to establish if training should proceed, or be altered or discontinued.

5 Kobayashi (Equine Vet J Suppl 1999 Jul;30:159-62) showed that by standardizing training regimes, heart rate and speed monitoring can provide a quantitative assessment of the effect of training by calculating the theoretical velocity the horse can achieve with a heart rate of 200 bpm (V200). This is achieved by measuring heart rate at a range of speeds and by using linear regression to calculate the theoretical speed at a heart rate of 200bpm. V200 was shown to increase with
10 fitness. The difficulty with implementation of this method in day to day training is that heart rate and speed measurements must be acquired and V200 calculated manually for each horse, which is a time consuming and skilled task prone to error in a day to day training environment.

WO2004/084624 describes a device in the saddle blanket that monitors equine
15 heart rate and velocity and can transmit this information to a trainer's PC via a radio data link. This allows a trainer to monitor a number of horses during training and automate the calculation of V200. The disadvantage however is that this apparatus requires hard wired connections between the blanket, girth and rider that are inconvenient in operation for example if the rider were to fall, and during
20 mounting and dismounting.

US 4,540,001 describes a heart rate monitor integrated into a girth. This apparatus does not include speed sensing so is limited in its ability to monitor heart rate only.

These inventions do not solve the problem of combining physiological,
25 biochemical, environmental and kinetic information into one device which is obtained during training for on the fly and or retrospective analysis of performance and performance improvement.

What is needed is a device for performance assessment and training, most particularly for use when training a horse. Embodiments of the invention are
30 directed to a device affixed to a horse to monitor the horse during exercise using a combination physiological, biochemical, environmental and kinematic sensors to

acquire process and display the performance metrics and type of exercise regime to be performed by the horse based upon a predetermined exercise programme.

SUMMARY OF THE INVENTION

5 In one embodiment the apparatus affixed to the horse monitors the physiological and biochemical status of a horse by incorporating one or more physiological biosensors and a processing means. The apparatus may be affixed to the horse using the girth, the saddle, saddle blanket or pad, harness, breastcollar or other tack, protective gear or horse clothing. The apparatus may transmit the signal from the sensors wirelessly using a proprietary communications protocol, or through
10 standard communications protocols such as Bluetooth, to a display unit. This display unit may be worn by a rider or trainer, or may be affixed to the saddle, bridle or harness. The display unit may also be a may be a laptop, PC, PDA or cellular phone. The data may be saved in a database for retrospective comparison along with similar data acquired in training regimes, and may be used to set the
15 training regimes. Data such as age, sex, weight, ID, vaccination, farrier record, track or course conditions, radiological or therapeutic intervention can be entered. There may be two way communications between the display unit and the rider or trainer for changing the training regime during the workout. Multiple horses may be trained simultaneously each with said device affixed to each horse where the data
20 is offloaded to a central display device for data storage, post processing assessment and training adjustment and advice. In addition the method of acquiring the data, processing the data and communicating the results in an automated fashion is disclosed. Integration of sensors with data processing in a single attachment to the horse is novel.

25 In another embodiment the sensors may be directly implanted in the animal. Examples include implanted glucose or other implantable or minimally invasive biosensors, physiological sensors such as temperature sensors, airway humidity sensors for determining cardiac output or other sensors such as those for measuring blood flow or A-VO₂ differences. Implanted identification devices such
30 as RFID chips which can transmit identity and or location of an animal can be included. Signals from these implanted or minimally invasive physiological, biological and radiofrequency sensors are combined in a central processing

means, and the data acquired used for optimizing performance in training and competition or in tracking or monitoring wildlife including but not limited to birds, fish, game and endangered or migratory species.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will now be further described, by way of example, with reference to the accompanying drawings, in which:

5 Figure 1 is a side view of the horse and rider showing the arrangement of the 'active girth' and 'display unit' in a form attached saddle”;

Figure 2 is a side view of the horse and rider showing the arrangement of the first element or 'active girth' and second element or 'display unit' in a form worn by the rider;

Figure 3 shows the second element or display unit in the form worn by the rider;

10 Figure 4 shows a saddle with the second element or display unit in the form of a unit attached to the pommel, and the first unit attached or embedded directly into the saddle (or “smart saddle”);

Figure 5 (a) shows top side of the first element or 'active girth';

Figure 5 (b) shows the bottom side of the first element or 'active girth'

15 Figure 5 (c) shows the top side of a sleeve incorporating the electronic system which can be fitted over an existing girth, to turn it into an 'active girth'

Figure 5 (d) shows the bottom side of a sleeve incorporating the electronic system which can be fitted over an existing girth, to turn it into an 'active girth'

20 Figure 6 shows a block diagram of the electronic system incorporated into the 'active girth';

Figure 7 shows a block diagram of the electronic system incorporated into the display unit;

Figure 8 shows example data recorded from a prototype system;

Figure 9 shows the layout of the display 3;

25 Figure 10 shows the layout of the display 2; and

Figure 11 shows the transfer of data between the elements of the system

Figure 12 shows an example training plan

DETAILED DESCRIPTION

It is the object of this invention to combine in a convenient manner all physiological, biochemical, ambient, gait, speed, distance and location parameters
5 into a single system for performance assessment in humans or animals, in particular equines.

In a first embodiment the invention provides an apparatus for use when training a horse, the apparatus comprising a first element and second element. The first element attaches to a horse and includes physiological, biochemical,
10 environmental or kinetic sensors. The sensors in use, generate signals indicative of the metabolic condition of a horse. The first element further comprises a processing means.

The second element of the apparatus comprises a display for displaying the type of exercise to be performed, which, in use, generates a training signal based upon
15 the signals received from the sensors and a predetermined training programme, the training signal being indicative of the type of exercise that the horse should perform at that time.

In a second embodiment of element one the sensors may be implanted in the horse and communicate wirelessly with the first element which contains a
20 processing means.

Embodiments of the apparatus preferably monitor the health state of a horse and the apparatus may therefore include the following features in a self-contained first element comprising of two or more sensors and processing means to monitor the sensors and derive data from them.

25 The first element may include (but is not limited to) one or more of the following sensors:

- An accelerometer
- A heart rate sensor.
- A skin temperature sensor
- 30 • A blood glucose or lactate sensor

- A position sensor (altitude, speed, distance)
- A breath sensor
- Environmental sensors such as humidity and ambient temperature
- A radiofrequency ID chip reader

5 In a preferred embodiment the first element may be (but not limited to) a girth, or a tubular cover or sleeve, which fits over a girth, or may be affixed to or embedded in a saddle. The first element may have a means of transmitting and receiving derived data with the second element to provide a data link. The data link may transmit data which has been processed by the processing means to reduce the
10 quantity of data. The first element preferably has sufficient memory to log and store data from sensors/inputs. The first element may include a means of transmitting and receiving data with an external PC or data network.

The second element may have a visual display and be embodied in a format that can be worn by the rider or alternatively embodied in a format that can be attached
15 to the saddle, the tack, or embedded in the saddle, or is a remote device such as a laptop, computer, cell phone or PDA.

The second element may be optional; its primary purpose is to provide live visualisation of sensor signals measured by the first element or to indicate a signal to direct the training. It may also be used as a means of configuring the first
20 element. The second element may have a means of transmitting and receiving derived data with the first element. The second element may have at least one electrical button which can be operated by the rider. This button could be in the form of a touch screen, joystick or other method. The first or second element may include a means of reading electronic identification tags which are commonly
25 implanted in horses to identify them. The second element may include a means of transmitting and receiving data with an external PC. The second element may be wrist mounted and may include a real time display of physiological parameters and velocity and gradient.

Further wired and wireless elements may be added to the system for additional
30 functionality. For example, the first element may communicate with a user's PDA or mobile phone. The first or second element may be configurable with a code chip, or wireless identity card or RFID card.

The apparatus preferably includes a one or more processors which, in use, run algorithms that process the data and make predictive outcomes. The system preferably compares current performance with records of previous performance or a predefined performance target.

- 5 Further advantages of the invention are realized when more than one horse is under training as it simplifies the management of training programmes and facilitates the analysis of performance of individual horses in a training group.

An example of the apparatus for monitoring the health status of a horse will now be described with reference to figure 1 to 12.

- 10 In one embodiment the apparatus consists of two elements; the 'active girth' 5 and a display unit either worn by the rider 3 or mounted to the saddle 2.

The active girth combines a girth with sensors and an integrated electronic system to process, store and transmit the data received from the sensors. The active girth is self-contained so that there is no additional equipment to be fitted to the horse compared with conventional tack, and no wires have to be connected which can be time consuming. Positioning of the sensors is reproducible and robust, reducing variation in signal or poor signal quality due to operator error. The preferred embodiment includes a heart rate sensor that detects electrical signals from the horse using two conductive pads 9 & 11, which are in contact with the horse's skin when the girth is fitted. It also contains a temperature sensor 10 that is held in contact with the horse's skin and a 3-axis solid-state accelerometer 18. It also contains environmental sensors 22, including ambient temperature and relative humidity sensor. It also contains a positioning system, in this case a GPS receiver 21, alternatives may include a terrestrial based radio triangulation system. Thus a particular benefit of the invention is that by combining a number of sensors into a single apparatus the calculation of performance indicators that are not possible from one sensor alone is now conveniently achieved. These performance indicators include, but are not limited to:

- V200 and VHRMax can be calculated from the heart rate and speed (derived from the position sensor)

- Gait frequency can be obtained from analysis of accelerometer data. When accelerometer data is combined with speed data, the stride length can be calculated. This is important in assessing work efficiency, fitness and for the detection of gait abnormalities as would be associated with lameness.
- 5
- Heat stress can be derived from ambient temperature and relative humidity and is a critical index of how the environment may effect performance, and thus more informative than either of these measurements taken individually
- Energy expenditure or calories consumed using measurements of heart rate, speed and gait pattern (e.g. trotting, walking etc) and body
- 10
- temperature may be used to derive a measurement of energy expended by the animal which can be used to guide feeding and training such as glycogen loading protocols.

A block diagram of the electronic system contained in the Active Girth is shown in figure 6. The processor reads the sensors and an algorithm may identify relevant

15

features from the data in order to reduce the quantity of data that has to be logged. The data is recorded in memory. In a preferred embodiment the active girth contains the electronics, rechargeable battery and sensors in a rugged and flexible enclosure that forms part of the girth (Figure 5 c & d). In the preferred

embodiment, the battery can be recharged wirelessly using an inductive power

20

transfer system. Alternatively, primary cells or wired recharging can be used. Sealed electrical contacts may be accessible for optional wired charging and communications, in this case using USB.

The electronic system of the Active Girth also includes a short-range radio telemetry system that is in this case Bluetooth. The main purpose of the short-

25

range telemetry system is to communicate with the display unit, but it may also be used to download data to another external device. Figure 11 indicates this communication. This communication link downloads data from the display unit's switches to the active girth, and uploads data from the active girth to the display unit. A second longer range radio modem in the active girth may be used to

30

communicate with an external PC. At a minimum this modem requires a range of 10 meters to allow download of data from a moving horse. Ideally the modem

would have a range of several kilometers so that the active girth could continuously be in contact with the PC during training. Alternatively this modem may utilize a cellular telephone network or other wireless data network (such as wifi). The modem may in fact be part of a cellular telephone, to which the active
5 girth communicates wirelessly (for example with Bluetooth). This network may allow direct access to the Internet or the trainer's PC or both. A secure data communication protocol may be required as a component of the data links used by the system because of the confidential nature of the data being transmitted. The telemetry protocol ensures that paired devices can only communicate with each
10 other even in the presence of other systems on other horses, and it ensures the data transfer is secure. This link allows data from the active girth to be downloaded to the PC, and configuration files and instructions to be uploaded to the active girth.

In another preferred embodiment the function of the active girth is undertaken by
15 the saddle. Sensors are embedded in the underside of the saddle as shown in figure 4 items 24 & 25 as is the short and or long range communication link and processor. Similar embodiments as described for the active girth can be envisioned for other types of horse tack such as bridles, breast collars, harness and horse clothing such as blankets or protective gear such as splint boots,
20 shadow rolls or fly masks.

The software architecture for the system may have several embodiments. In a first embodiment the algorithms that calculate performance metrics from the data recorded from the sensors could reside in the processors in 4 and 3. In this embodiment the system operates independently of the PC. In this embodiment the
25 system may store metrics from previous training sessions for comparison. In a second embodiment the system sends sensor data to the PC for storage and the algorithms operate in software on the PC. These metrics are then sent back to the system. In a third embodiment the system sends the data to a secure server on the Internet for storage and processing of the data. This may be sent directly from
30 the horse based system which acts as the client, or via the PC which acts as the client. The server then returns the calculated metrics to system by a reverse process. In a fourth embodiment the system processes the data from the sensors and calculates performance metrics. These metrics are sent either directly or via a

PC to the Internet based secure server. The server stores the data and processes it to calculate changes in these metrics over time and present these graphically via user interface. This data could be accessed by trainers and owners over the Internet using a PC with a web browser. A fifth embodiment that combines all of
5 these embodiments is also possible.

Where the long range radio system is installed and permits live monitoring of the horse, it may be used during competition to display live performance data to team members and spectators. Where more than one horse in the same competition is provided with the system, then live comparisons of performance (such as race
10 position or metabolic status) can be provided to the team members, spectators or third party equipment.

The display unit has two possible configurations shown in Figure 3 and Figure 1, both share the same electronic system shown in Figure 6. This comprises a wireless transceiver (in this case Bluetooth) which receives data and commands
15 from the active girth or smart saddle. The processor manipulates the data for the display 12 or 17. In the preferred embodiment the screen is an LCD display with a touch screen, but separate buttons surrounding the screen are an alternative. The embodiment shown in Figure 3 is most suitable for the training of racehorses and an example display layout for this application is shown in Figure 9. The
20 embodiment shown in Figure 1 is most suitable for endurance racing and an example display layout for this application is shown in Figure 10. The purpose of the touch screen or buttons is to allow the rider to indicate the start and end of each new training task or race leg. Feedback from the buttons/touch screen on the display unit may be passed back to the active girth for storage in non-volatile
25 memory with other data, for example, to indicate the start of training. The display unit in the case of 1 may be a PDA with customised software. In the case of Figure 3, the display unit may also function as a wrist-watch with timing functions.

An example data set received by the PC is shown in Figure 8.

The operation of one embodiment of the system is described below.

30 The trainer logs on to the Internet based secure server, selects the horse to be trained and selects from a library of generic training regimes offered on the server

depending on the training effect required. The trainer can also define custom regimes. The regime may be suggested by the server software based on statistical analysis of past performance of that horse. Figure 12 illustrates a typical regime.

When the generic regime is selected the client server software may customise it by referencing horse past performance data and information regarding the training site to be used stored on the server. This data may include V200, HRmax, location, length and gradient of training track. The server software then calculates the target heart rates, horse speeds and repetitions, adds warm up and cool down sequences, and creates a customized training profile specifically for the training session. The data is downloaded via the internet from the client server to a PC located at the stable. As the horse leaves the stable for the training session, the regime is downloaded wirelessly to the processor in the horse based system. Alternatively the training regime can be saved onto a chip which is manually loaded into the processor.

The horse based system then implements the training session and prompts the rider to start the training programme via the display unit. First the software indicates to the rider to start the warm up by requesting sequences of slow speed exercise. This is done by displaying a target speed and actual speed on the display unit for a predetermined time or for so long as the horse is exercising within a predetermined training area, so the rider can aim to match the horse speed to the target speed to provide the proper exercise stress. Execution of these sequences is monitored by the software by reference to the GPS data and other physiological sensors. The training and cool down sequences are then prompted in a similar way. In another embodiment new training sequences can be loaded on the fly to alter training mid stream if performance metrics dictate.

The training plan may also be used as a means of indicating a race strategy to the user, and or an aid to navigating the course. This has particular advantages in endurance competition, in which it is essential for success to correctly pace the horse. In this case, the training plan may be dynamically updated by the device depending on how the course has been ridden so far, or can be adjusted by the support team during the periodic veterinary checks to take into account observations on the horse's welfare.

The software in the horse based system also performs fitness checks during training based on the sensor data. These may include heart rate recovery rate, gait, body temperature, environmental heat stress etc. The rider is warned if normal parameters based on previous training performance or welfare guidelines are exceeded. During the training the sensor data and calculated metrics are logged and uploaded back to the stable PC as the horses return from training. This data is then uploaded to the server via the Internet. The data is then added to the database for that horse and the graphical analysis of the horse's fitness over time is updated. The server software allows the trainer or owner to compare current performance against previous sessions with the same regime over the same track. This gives easily understood trends for the trainer to see changes in performance.

In another embodiment groups of horses can be trained remotely using the training regimens which may be started using an electronic "gate". Horse and rider identification can be retrieved through electronic identification as the horses pass through the electronic gate. Simulation of race conditions to measure performance metrics between groups of horses in similar or different training regimes can thus be conveniently obtained and compared for performance outcomes studies. Results can be sent remotely to owners PDA's, cellular telephones, laptop computers or to a website.

A problem with analysing the data provided by the system is that there are many environmental factors that will effect the reaction of the horse to a given training stimulus. To address this problem an improved method of data analysis may include comparison of physiological data with training data just from those training sessions undertaken in similar training conditions. This may include the selection of training data for comparison from data taken from the same training course, duration and intensity as determined by analysis of the position sensing data, and optionally data collected with the same rider, similar weather conditions, ground state or at a similar stage in the season's training programme. This method makes changes in the fitness of the horse more noticeable in the physiological data.

This process may be enhanced further by normalisation of the physiological data using physical and environmental data.

CLAIMS

1. An apparatus for monitoring performance, comprising a first element and a second element. the first element for attaching to a human or animal, containing two or more of physiological, biochemical, kinematic, and/or environmental sensors and a processing means which records in memory signals or derivatives of signals from said sensors and contains a means of re-transmitting this data to the second element; the second element containing a display or audio output to present the processed live or previous recorded data to the user.
2. The apparatus of claim 1, with either first element or the second element contains a processing means which compares sensor data with a pre-defined reference and generates additional data indicative of the difference between the data and the reference.
3. The apparatus of claim 2 where the reference is provided by an external input, which can be updated whilst in use.
4. The apparatus of claim 2 where the reference is determined all or in part by an automatic algorithm with reference to previous data.
5. The apparatus of claim 2 where the reference is in the form of a training programme.
6. The apparatus of claim 1, in which one of the sensors is a physiological sensor.
7. The apparatus of claim 1 in which one of the sensors is a heart rate monitor.
8. The apparatus of claim 1, in which one of the sensors is a position sensor
9. The apparatus of claim 1 in which one of the sensors is a biosensor
10. The apparatus of claim 9 where the biosensor is a lactate sensor
11. The apparatus of claim 9 where the biosensor is a glucose sensor

12. The apparatus of claim 1 where the animal is a horse
13. The apparatus of claim 12 where the first element is for attachment to or part of the horse's tack
14. The apparatus of claim 13 where the first element is integrated into the girth or integrated into a saddle, or as an attachment to the girth or the saddle.
- 5
15. The apparatus of claim 14 where the girth attachment for element 1 is a girth sleeve
16. The apparatus of claim 1 where the first element is designed in such a way as to minimise variation between sensor data due to positional variation in attachment of the sensor
- 10
17. The apparatus of claim 1 where the means for transmitting data is wireless
18. The apparatus of claim 1 where the means for transmitting data can also receive data from the second element.
19. A method for training which uses one of more reference signals to guide the training where the reference signal is derived from an apparatus for monitoring performance, the method comprising:
- 15
- (a) providing a first part for attaching to a human or animal, having two or more of physiological, biochemical, kinematic, and/or environmental sensors and a processor to record the signal from said sensors;
- 20
- (b) and attaching the first part to a human or animal;
- (c) obtaining data using said two or more sensors;
- (d) the first part having a means of re-transmitting the data to an external device for storage, display or analysis;
- 25
- (e) transmitting said data to said external device;
- (f) using said data to assist in determining the effort to be

expended by the human or animal during training.

20. The method according to claim 20 in which the user can view previously acquired data to make a training decision.

5 21. The method according to 20 allowing an external input to provide a training programme which can be updated whilst in use

22. The method according to claim 21 where the external input can be wireless, audio or from a pre-coded chip

10 23. The method according to claim 20, where a training programme is determined all or in part by an automatic algorithm with reference to previous data.

24. The method according to claim 20, in which the reference signal is also used to illustrate a competition route or race strategy to the user

15 25. A method for training which uses one or more reference signals to guide the training of several humans or animals in a group where the reference signal is derived from an apparatus for monitoring performance, the method comprising providing:

20 (a) providing a first part for attaching to a human or animal, having two or more of physiological, biochemical, kinematic, and/or environmental sensors and a processor to record the signal from said sensors;

(b) and attaching the first part to a human or animal;

(c) obtaining data using said two or more sensors;

(d) the first part having a means of re-transmitting the data to an external device for storage, display or analysis;

25 (e) transmitting said data to said external device;

(f) using said data to determine the effort to be expended by the human or animal during training.

26. The method of claim 25 where an identification chip is worn by an animal, the identification chip possessing therein information about the animal such as name, age, weight, gender or patient ID.

5 27. The method of claim 25 where an identification chip is worn by a human associated with the animal, the identification chip possessing therein information about the human such as name and weight.

10 28. The method of claim 26 where identification chips are worn both by a human associated with the animal and by the animal, the identification chip with the human possessing therein information about the human such as name and weight and the identification chip with the animal possessing therein information about the animal such as name, age, weight, gender or patient ID.

29. The method of claim 25 where the data acquisition is commenced when the animal or human passes through an electronic gate

15 30. The method of claim 25 where the apparatus for monitoring performance is configured when the animal or human passes through an electronic gate which is only large enough for one animal to pass through at a time which reads the identification chips and transmits that data to the said apparatus.

31. The method of claim 28 where data is acquired from sensors linking the animals and associated humans in a training session.

20 32. The method of claim 26 where the apparatus provides the ability to interrogate more than one animal or horse at the same time

33. The method of claim 25 where the apparatus may display comparisons between animals or humans

25 34. The method of claim 25 where the apparatus can place animals or horses into groups and assign training programmes to groups or individuals

35. A method for training which uses one or more reference signals to guide the training of several humans or animals in a group where the reference signal is derived from an apparatus for monitoring performance, the method comprising:

- i. providing a first part for attaching to a human or animal,

having two or more of physiological, biochemical, kinematic, and/or environmental sensors and a processor to record the signal from said sensors;

- ii. and attaching the first part to a human or animal;
- 5 iii. obtaining data using said two or more sensors;
- iv. the first part having a means of re-transmitting the data to an external device for storage, display or analysis
- v. transmitting said data to said external device;
- 10 vi. using said data to assist in determining the optimum effort to be expended by the human or animal during training.

wherein the reference signals may be adjusted using previously acquired data.

36. The method of claim 35 where the reference signals may be adjusted using data taken from other sources external to the apparatus.

15 37. The method of claim 35 where the reference signal may be adjusted using data taken periodically from other devices external to the apparatus which measure the animal's physiology.

38. The method of claim 35 where the reference signals may be adjusted using data taken from sources external to the apparatus that measure the training environment.

20 39. The method of claim 35 where the reference signal may be adjusted using data taken from sources external to the apparatus that provide information on parameters that are related to the animal and the human.

25 40. A method for training which uses a reference signal to guide the training of several humans or animals in a group where the reference signal is derived from an apparatus for monitoring performance, the apparatus comprising:

- i. providing a first part for attaching to a human or animal, having two or more of physiological, biochemical, kinematic, and/or environmental sensors and a processor to record the

signal from said sensors;

- ii. and attaching the first part to a human or animal;
- iii. obtaining data using said two or more sensors;
- iv. the first part having a means of re-transmitting the data to an external device for storage, display or analysis;
- v. transmitting said data to said external device;
- vi. using said data to assist in determining the optimum effort to be expended by the human or animal during training;

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wherein the algorithms used to produce the reference signal use data from more than one sensor within the apparatus.

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41. The method of claim 40 where the algorithms use additional data taken from sources external to the apparatus.

42. The method of claim 40 where an adjustment step is performed on the data from the sensors with reference to data taken from other devices and data stored from previous training events.

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43. The method of any of claims 19-42, wherein the step of using the data comprises determining a target running or walking speed for the human or animal and/or or the duration for which exercise should be performed.

44. Apparatus for use when training a horse, the apparatus comprising a first part for attaching to a horse and a second part, the first part including at least one biometric sensor and at least one accelerometer, the at least one biometric sensor, in use, generates a biometric signal indicative of at least one biometric condition of a horse to which the first part is attached and the accelerometer generates an acceleration signal indicative of acceleration of said horse, the apparatus further comprising a processing means which, in use, generates a training signal based upon the acceleration signals and the biometric signals received from the sensors and a predetermined training program, the training signal being indicative of the type of exercise that the

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horse should perform at that time and the second part of the apparatus comprises a display for displaying the type of exercise to be performed.

5 45. Apparatus as claimed in claim 44, in which the apparatus further includes a GPS locator which generates a location signal, the training signal being generated by the processing means is then also based upon the location signal.

10 46. Apparatus as claimed in claim 44 or claim 45, in which the at least one biometric sensor is selected from a list composed of a heart rate monitor, a temperature sensor, a blood oxygen monitor.

15 47. Apparatus as claimed in any of claims 44-46, in which the first part of the apparatus is built into a saddle or girth for attaching to a horse.

48. Apparatus as claimed in any of claims 44-47 in which the first part and second part are not physically connected and communicate wirelessly.

20 49. Apparatus as claimed in any of claims 44-48, in which the apparatus further comprises means for receiving training data from a computer, the training data being used to set the predetermined training program.

25 50. Apparatus as claimed in any of claims 44-49, in which the apparatus further includes a memory element, the memory element being for recording data indicative of the signals from the at least one sensor.

51. Apparatus as claimed in claim 50, in which the apparatus further includes means for transmitting stored data to a computer.

30 52. Apparatus as claimed in any of claims 44-51, in which the apparatus further comprises means for receiving training data from a computer, the training data being used to determine the predetermined training program.

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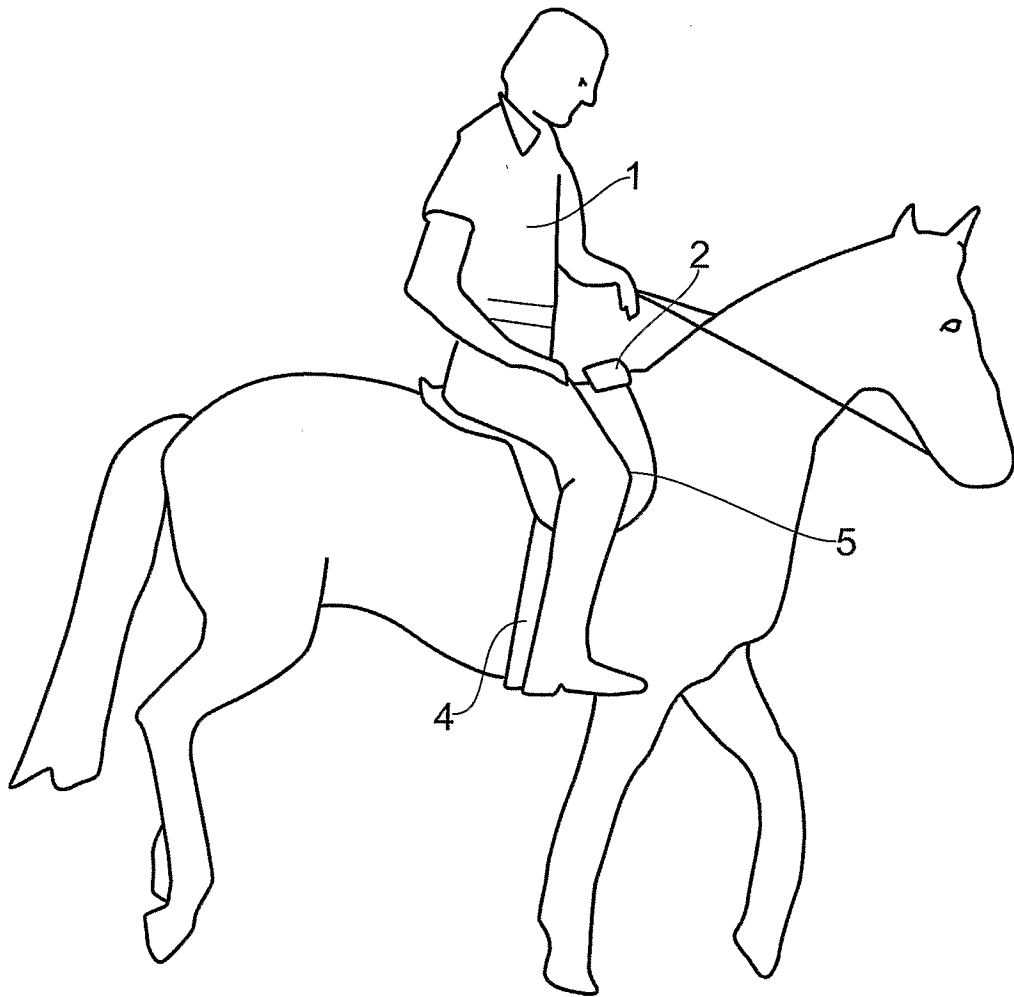


FIG. 1

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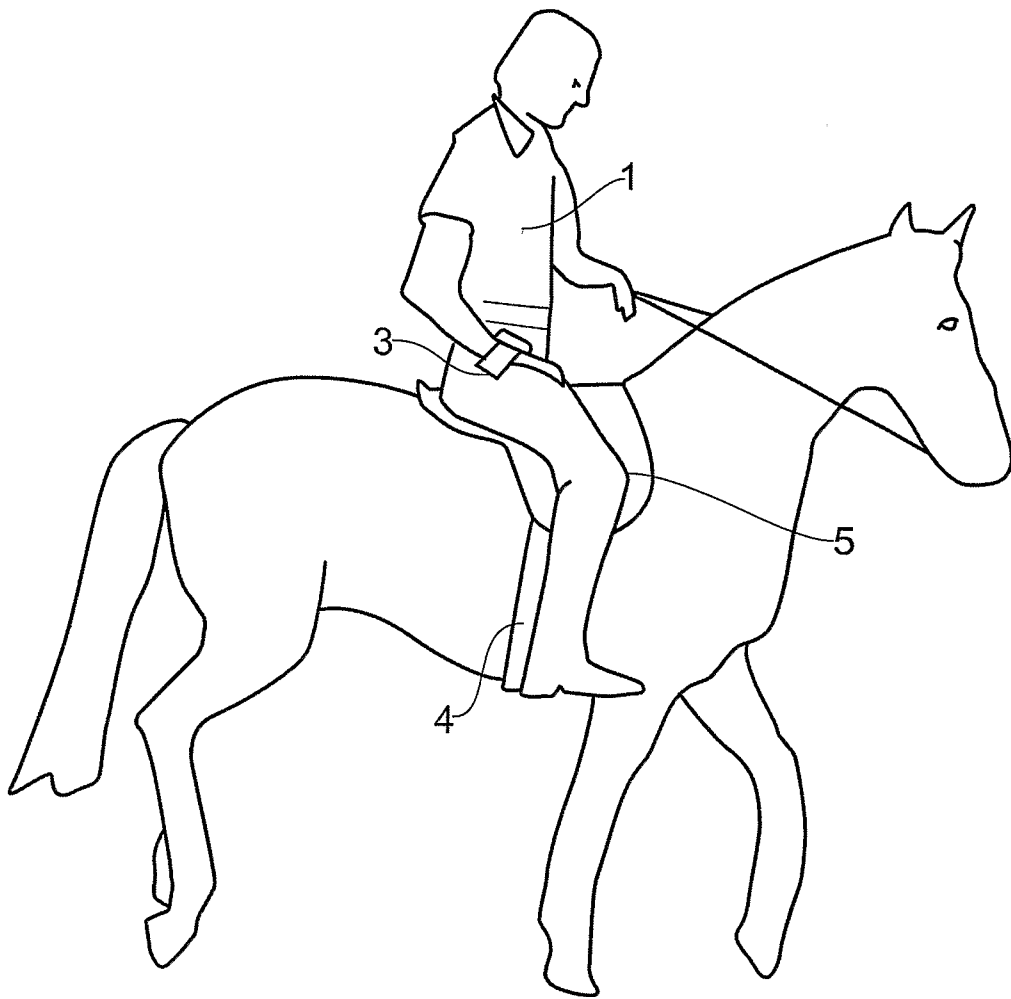


FIG. 2

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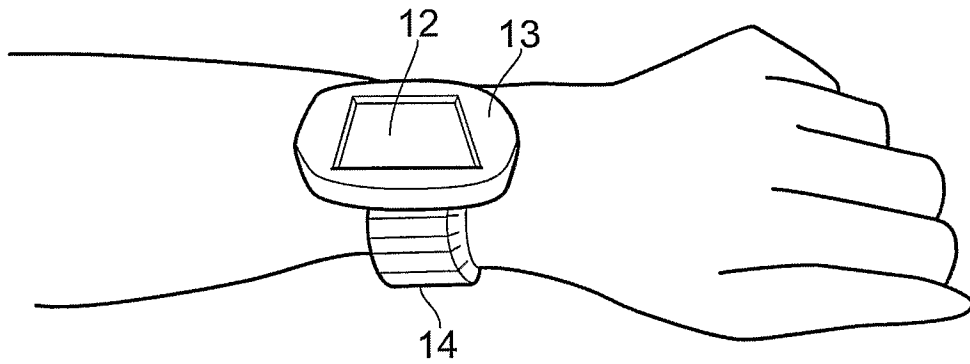


FIG. 3

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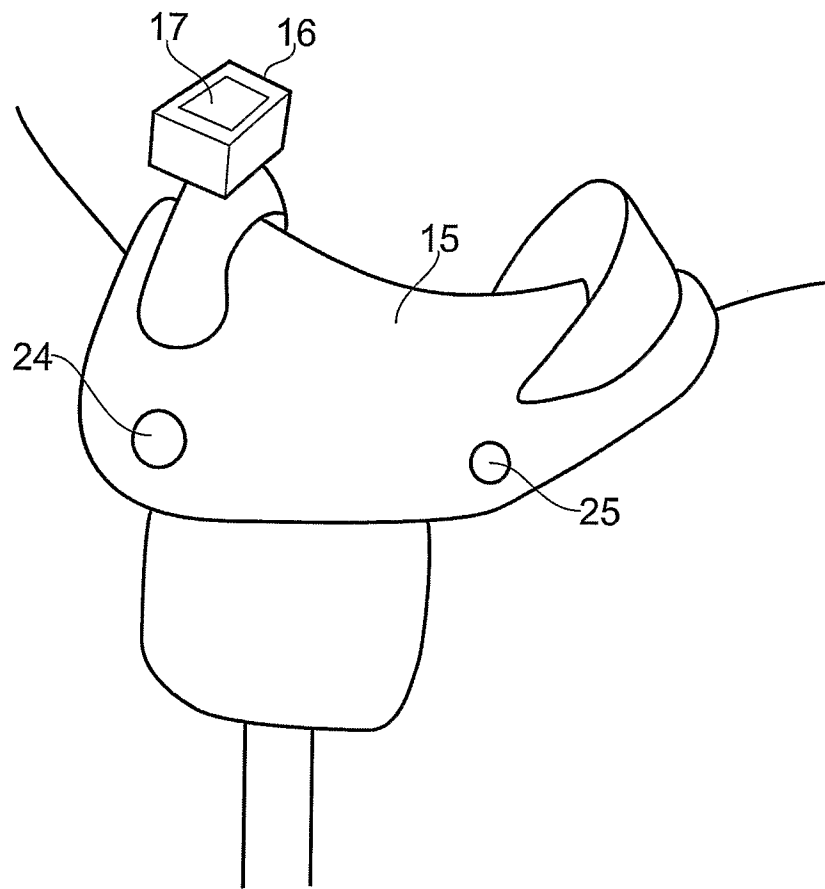
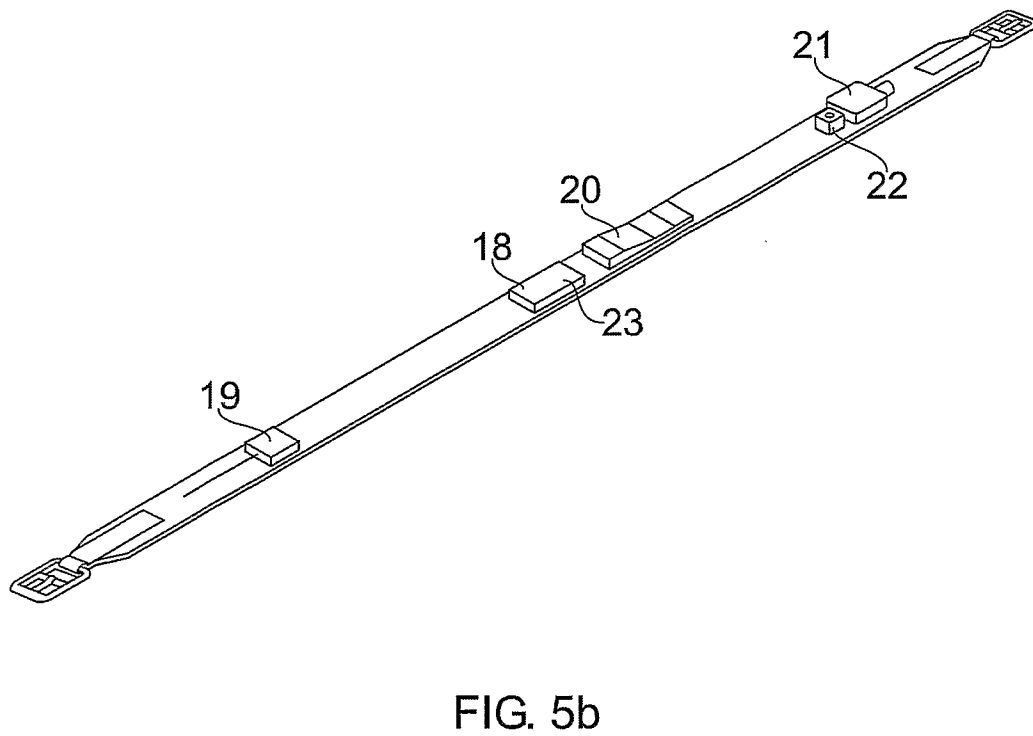
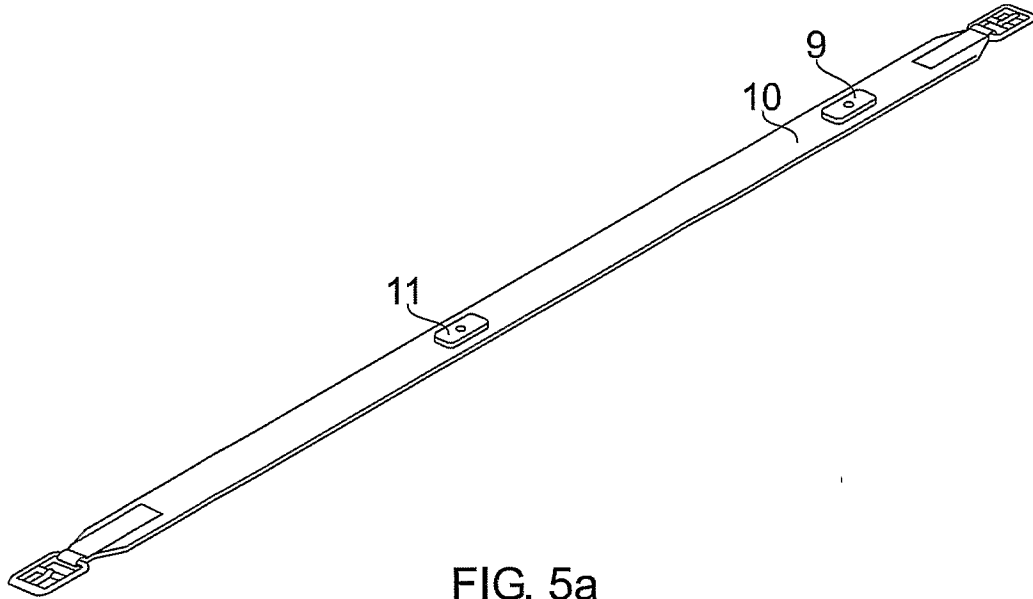


FIG. 4

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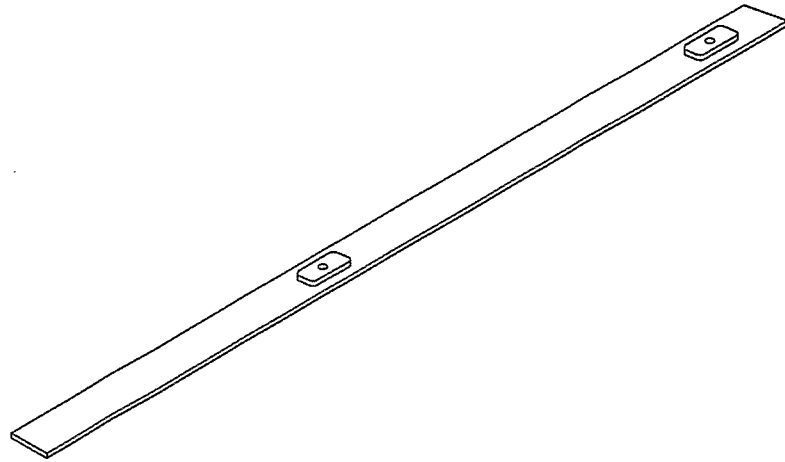


FIG. 5c

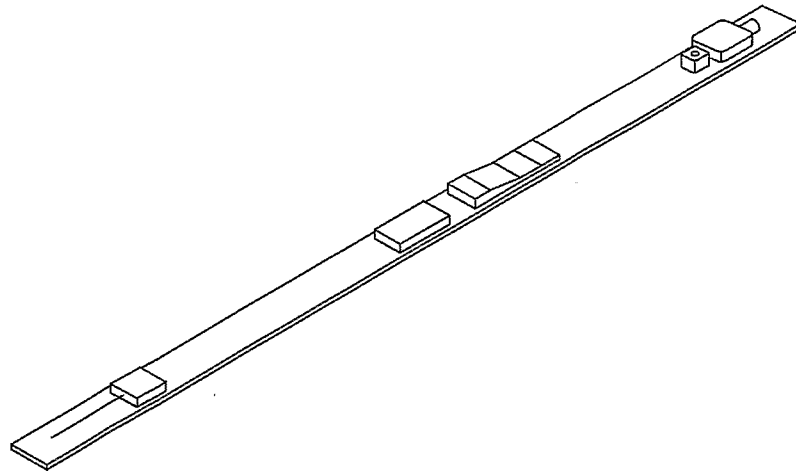


FIG. 5d

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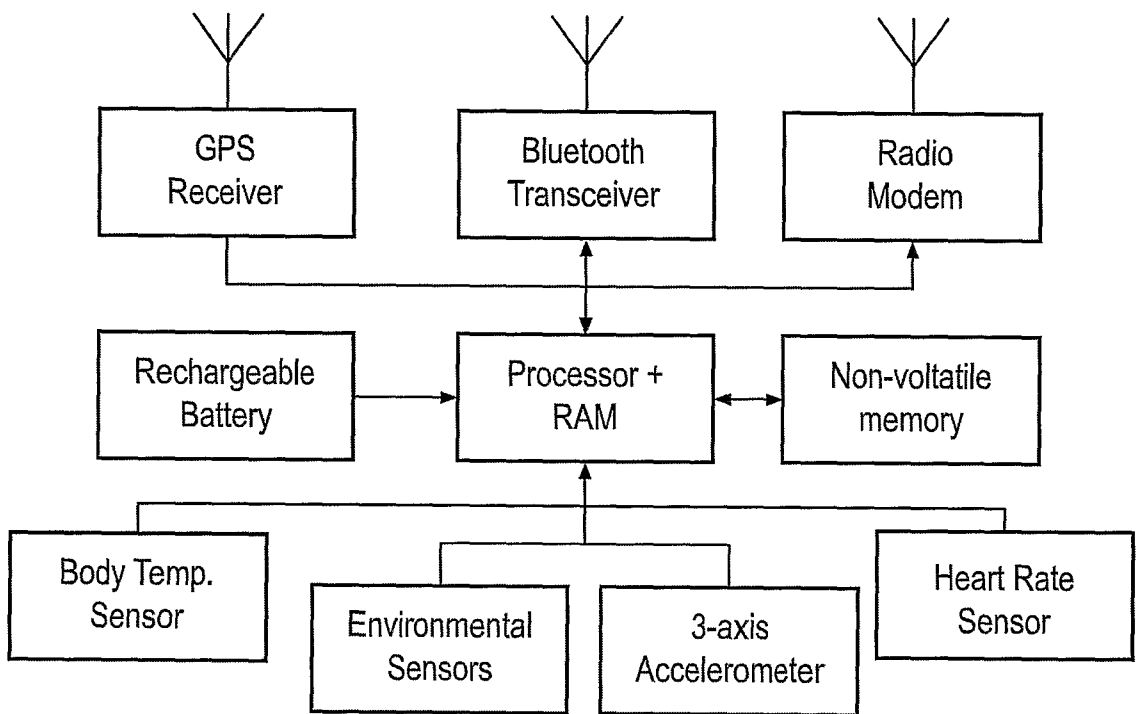


FIG. 6

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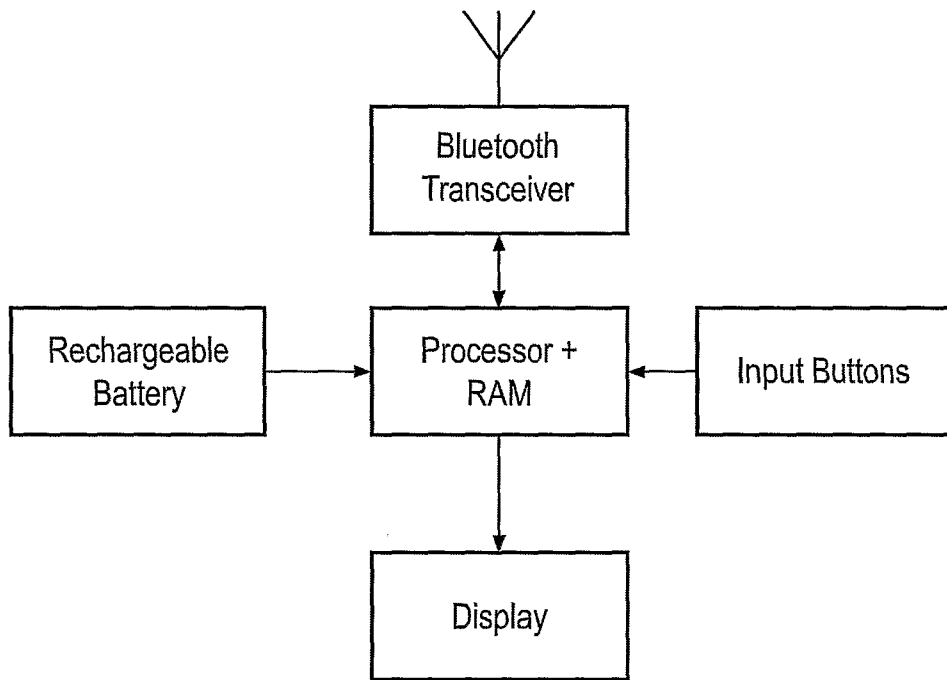


FIG. 7

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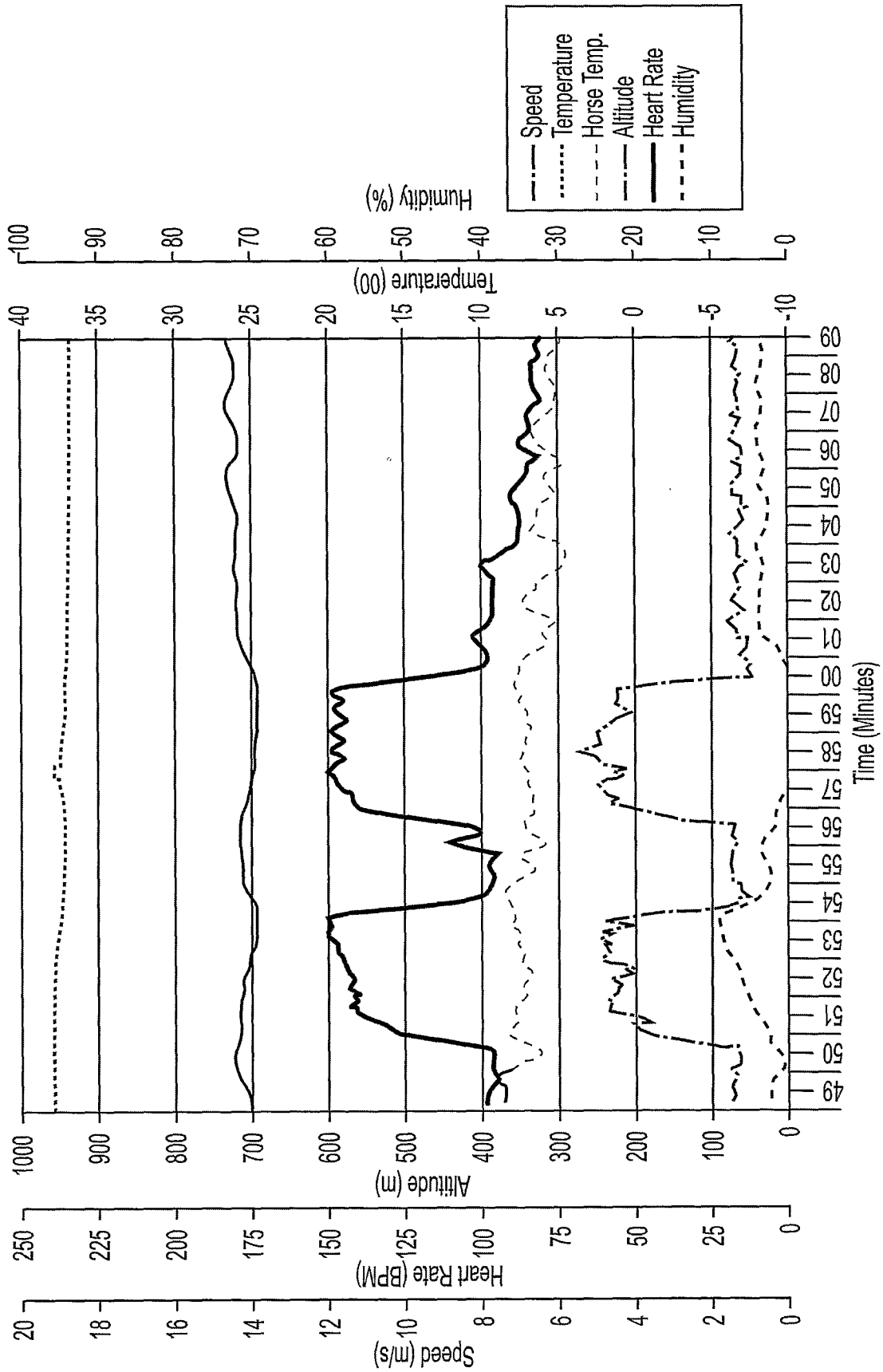


FIG. 8

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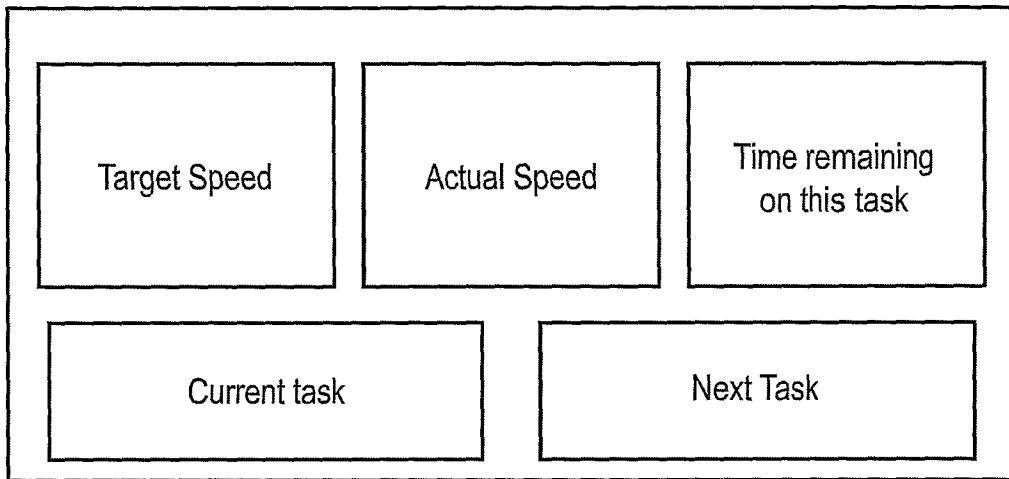


FIG. 9

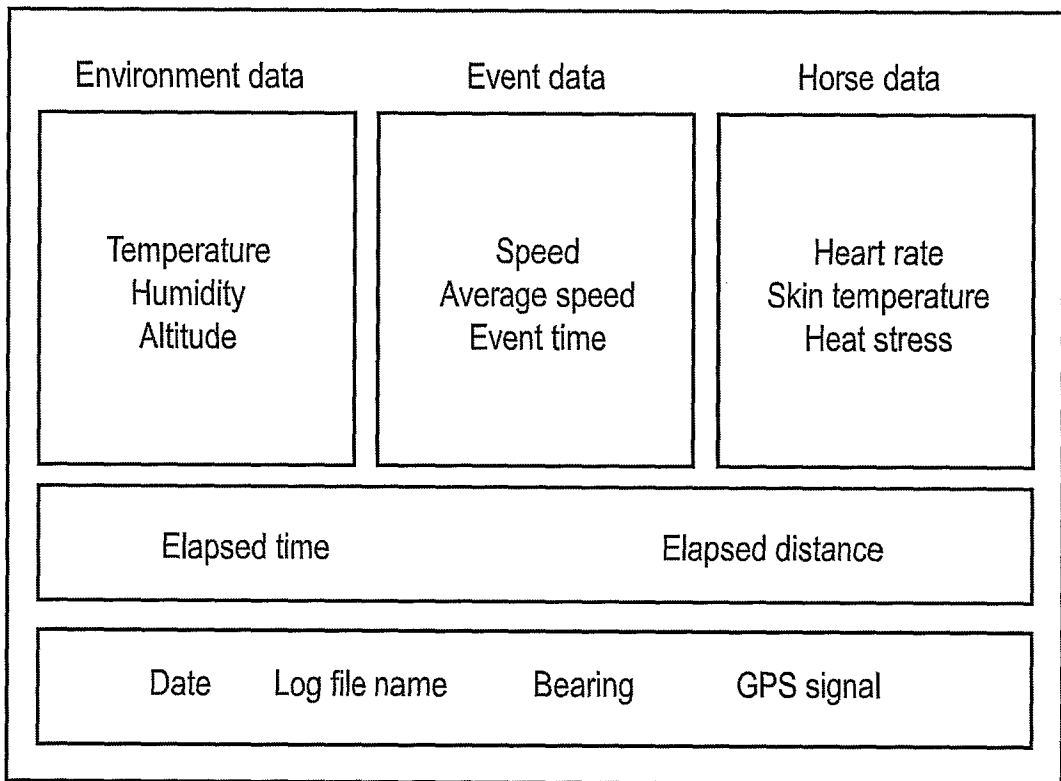


FIG. 10

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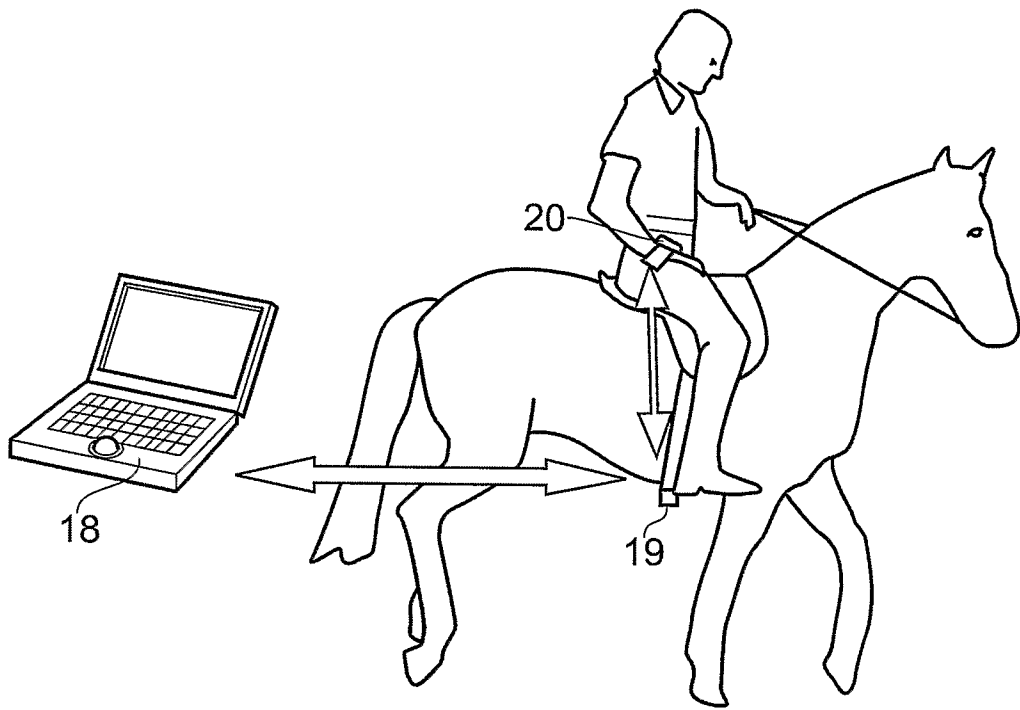


FIG. 11

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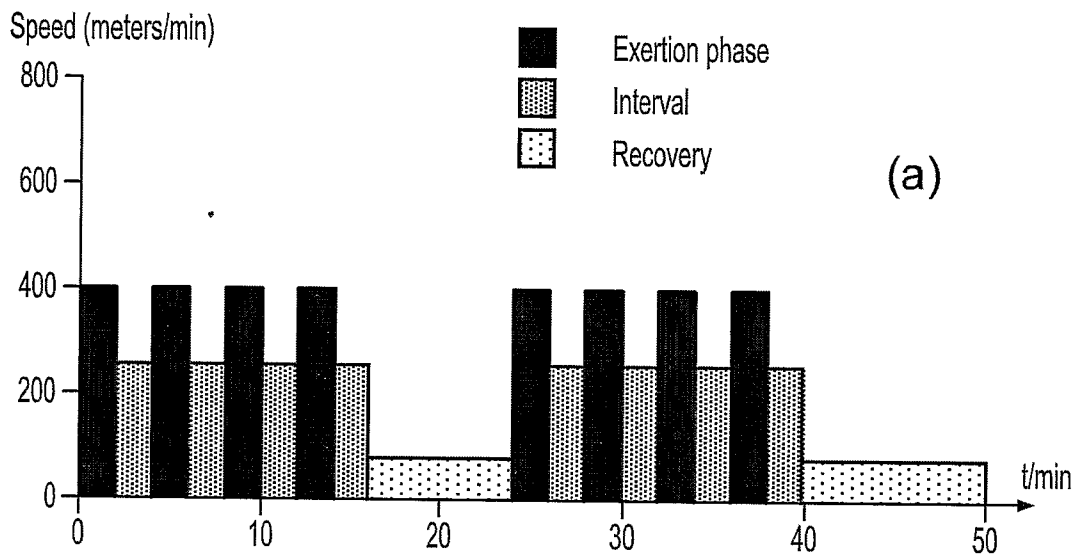


FIG. 12

INTERNATIONAL SEARCH REPORT

International application No

PCT/GB2007/001809

A. CLASSIFICATION OF SUBJECT MATTER INV. A01K29/00		
According to International Patent Classification (IPC) or to both national classification and IPC		
B. FIELDS SEARCHED		
Minimum documentation searched (classification system followed by classification symbols) A01K A61B		
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched		
Electronic data base consulted during the international search (name of data base and, where practical, search terms used) EPO-Internal, WPI Data		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 2005/004999 A (FUSION SPORT INTERNAT PTY LTD [AU]; DEUTSCH MARKUS [AU]; MOORE DOUGLAS) 20 January 2005 (2005-01-20) page 1, lines 15-33 page 3, line 28 - page 14, line 11; figures 1,2	1-52
X	WO 01/08417 A1 (BOK JOSEPH CHARLES [US]) 1 February 2001 (2001-02-01) pages 1-15; figures 1-5	1-52
P,X	WO 2006/119345 A (AWARE TECHNOLOGIES INC [US]; DEVAUL RICHARD W [US]; BARKALOW DANIEL [U]) 9 November 2006 (2006-11-09) page 9, line 7 - page 24, line 25	1-25,35, 36,38, 40-43
	----- -/-- -----	
<input checked="" type="checkbox"/>	Further documents are listed in the continuation of Box C.	<input checked="" type="checkbox"/>
		See patent family annex.
* Special categories of cited documents :		
A document defining the general state of the art which is not considered to be of particular relevance		*T* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
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L document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)		*Y* document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.
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Date of the actual completion of the international search	Date of mailing of the international search report	
11 October 2007	19/10/2007	
Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Authorized officer LUCCHESI-PALLI, C	

INTERNATIONAL SEARCH REPORT

International application No
PCT/GB2007/001809

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 2004/084624 A (EQUITRONIC TECHNOLOGIES PTY LT [AU]; STUART ANDREW KEVIN [AU]; EVANS D) 7 October 2004 (2004-10-07) cited in the application the whole document -----	1-52

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/GB2007/001809

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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			EP 1648575 A1 26-04-2006
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			JP 2006523092 T 12-10-2006
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